the refractory is subject to erosion or chemical action, as both of these forms of attack are more rapid at high temperatures. Reducing their temperature increases their resistance to such attack. Another function of water cooling is in reinforcing the rigidity of the binding of the furnace. Metal work exposed to heat will warp; cooling the metal prevents warping and holds the furnace to line. It is possible, however, to overdo the cooling; it, therefore, requires careful consideration, and the apparatus must be designed in such a manner that all steam and air pockets are avoided. With an open-hearth furnace, as with a blast furnace, cooling should only be used to hold vital points which cannot be held in any other way.

Thermal insulation for the conservation of heat will only be successful where the maximum temperature to which the refractories are exposed is less than their yielding temperature and where a sufficient thickness of the refractory is interposed to protect the insulation from temperatures above its yield point. In some cases the insulation will replace a certain amount of refractory brick, which serves to reduce the cost of the insulation; in other cases the insulation will be an addition to the cost of the refractories. The whole question must be settled on the basis of *"Will it pay?"* The balance between the cost of the thermal insulation and the value of the heat which it makes available for other purposes must not only pay the interest upon the investment, and supply funds for maintenance, etc., but must replace the capital invested. It is needless to say that the output of the waste-heat boiler will be increased by the delivery of high-temperature gases.

Waste-heat boilers are an indirect means of heat recovery. The main purpose of the furnace is the production of steel, and auxiliary apparatus cannot be permitted to

interfere with this.

Considerable diversity of opinion exists in regard to waste-heat boiler design and installation, the type of boiler and the method of baffling.

High gas velocities have been considered necessary for rapid heat transfer from gas to water. Such velocities mean a considerable draft differential through the boiler and are based upon the idea that, at high velocities, stream-line flow of the gases is replaced by confused eddies. Stream-line flow cannot occur with gases which are in contact with surfaces hotter or cooler than